MAPLE CANYON STREAM REHABILITATION PLAN & DESIGN TOOLKIT SPECIFICATIONS

For Sustainable Floodplain Stabilization and Ecosystem Restoration

April 27, 2017

As funded by the State of California Coastal Conservancy and by in-kind services, we present these DRAFT Plan and Design Toolkit Specifications – a scalable approach to implementation tailored for Maple Canyon. We look forward to input for strengthening both the presentation and project.

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PROJECT OVERVIEW

We have worked for almost a year with the City of San Diego, our consultants and the community, as well as with state and federal agencies, to achieve a strong, practical, efficient approach to abating erosion and sedimentation and to increasing habitat in Maple Canyon. While grade controls are the fundamental method and proven strategy proposed for Maple Canyon streambed stabilization, the goal here is to use a standardized methodology that can better address dynamic, ever-changing environments to restore healthful stream function in coastal canyons across the county.

Our "drainage restoration" methodology uses fully engineered design elements and a systematic, modular approach, to achieve natural canyon functions. The restoration contractor can employ a "toolkit" of engineered Tables, Graphics and Guidelines in the field, to locate, size, and install a series of (bioengineered and modular) grade controls within the channel. These grade controls will establish a "spine" down the length of the canyon. This spine will create a framework for trapping sediment. It will also increase infiltration and densely vegetating areas around the grade controls as well as extending riparian vegetation laterally from the stream to the bottom of slopes and to other infrastructure, such as storm-drain outfalls and trails. Recontouring, boulders, and planting will integrate the infrastructure (storm-drain outfalls and trails) with the plateaus between grade controls.

These design elements, when properly applied, stabilize the channel bed and banks within the canyon. The grade controls will slow down channel flows and allow the reestablishment of native vegetation in the canyon floor, which slows flows even further. <u>That this methodology is not constrained by a site-specific grading plan enables adaptation to field constraints. It minimizes the project footprint and hardscape. The system itself will require little or no maintenance.</u>

We have met with and maintained communication with the City of San Diego (City) Storm Water Division staff over these months, sometimes with our consultants in tow. We have had two meetings with the Public Works Department's storm-drain retrofit teams, once onsite. The City's project name for its storm-drain retrofit is "Maple Canyon Restoration, Phase 1. In these meetings, City staff has referred to our canyon-floor project as "Maple Canyon Restoration, Phase 2."

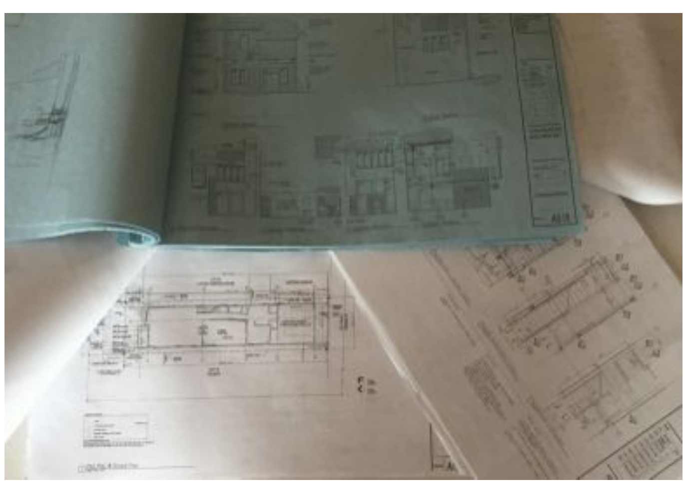
We have met with consultants for unhappy property owners receiving sediment downstream from Maple Canyon, including consultants to Solar Turbines. We presented our Design Toolkit Specifications at the Pre-Ap Agencies meeting in February. There, we received a supportive response for the in-field flexibility that allows adaptation to dynamic environmental constraints. Further, we have cultivated communications with other potential partners at the Coastal Conservancy, USFWS, CDFW, USACE and RWQCBs – all with ardent interest in solutions.

Our expert team is committed to converting Maple Canyon's catastrophically incised stream channel into a stable, densely vegetated riparian corridor that serves as both an ecological and hydrological resource. Our "drainage restoration" approach can be utilized to revitalize not just Maple Canyon, but coastal canyons throughout the region.

DECISION PROCESS

Overarching Problem: Throughout the county, developed and impermeable mesas, combined with municipal infrastructure, increase runoff volume and concentrate storm water, thereby intensifying flow velocity that generates severe erosion down-gradient in undeveloped coastal canyons. This escalating erosion robs open space of functioning ephemeral streams, infiltration, and habitat. It also exposes downstream properties to flooding and sedimentation, which ultimately have deleterious effect on marine resources. These effects are costly and leave property owners vulnerable to complaints, fines, and litigation.

Technical Problem: In dynamic canyon settings, the impacts of falling trees, habitat degradation, and human impacts routinely alter the landscape, and each storm brings new destruction. Traditional engineering and grading plans are costly and often become outdated and inaccurate representations of these easily mutable landscapes. Traditional engineering and grading plans are therefore inadequate. A less costly and timely means of addressing topographical changes and other field constraints is desperately needed.



Physical Problem: Maple Canyon is a dramatic example of unintended hydromodification impacts. Worsening conditions have long frustrated the City of San Diego, its environmental consultants, nearby neighbors, and downstream businesses as well as regulators. Maple Canyon's sediment trap fills rapidly each rainy season and overflows into Maple Street below. The nearest storm drain inlet, a block and a half below the canyon, is prone to clogging with sediment and contributes to flooding. Solar Turbines, three-quarters of a mile away, is on record as receiving Maple Canyon sediment. And within the canyon, the channel is head-cutting dramatically upstream with every storm, worsening channel slump, while threatening canyon access and slope stabilization. The channel is over 14 feet deep and 12 feet wide in places.

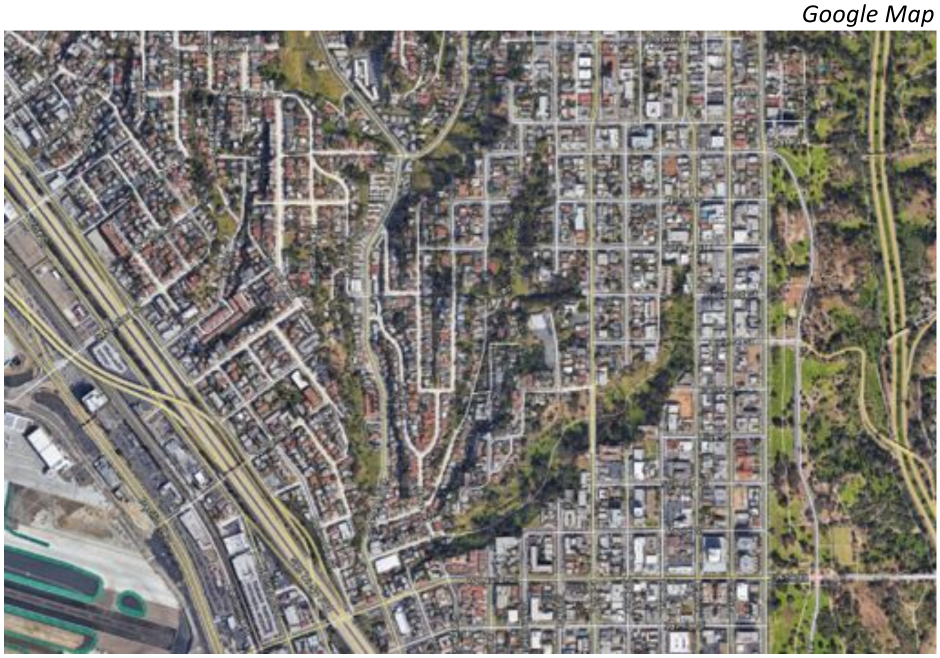
Photo of Sediment Trap at the bottom of Maple Canyon

SITE CONDITIONS

Located in San Diego west of Balboa Park, Maple Canyon is of modest size – approximately 20 acres, with a 0.4 linear mile stream-course. According to City of San Diego studies, its watershed is about 90 acres (with about 70 acres urban development). In just a 2-year storm its peak flow rate is around 79 cubic feet per second (cfs). The canyon is in the Pueblo San Diego Watershed, at GPS coordinates: 32º 43'58.10" N 117º10'00.51 W, and appears on FEMA's National Flood Hazard Layer Panel 06073C1885G, effective May 16, 2012.

Flood Map

Google Map



Maple Canyon, while not within the City's Multiple Habitat Preserve Area (MHPA), is beloved by the community and used as a pedestrian trail between Little Italy and Hillcrest. The canyon has vestiges of Coastal Sage Scrub, Coast Live Oak Woodland, Maritime Succulent Scrub, and chaparral, but the riparian region is almost entirely invasive nonnatives, apart from a few mature *Quercus agrifolia*. Upland drainages below existing storm drains are thickly vegetated and often contain Lemonadeberry, Toyon, and other native species.

The canyon floor exhibits appalling erosion and increasing sediment loss. The primary cause of this erosion is increased runoff from the surrounding watershed's now mostly impermeable surfaces. Increased runoff and inadequate storm-drain structures, combined with various floodplain disturbances, have resulted in dramatic ephemeral-stream channel incision and significant sediment transport.

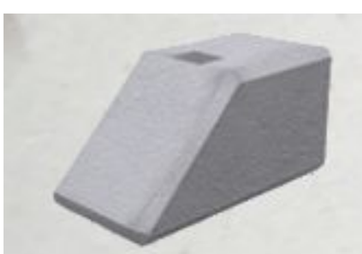
DESIGN PROCESS AND DESCRIPTION OF METHODOLOGY

Standardizing to Increase Wetland and Stormwater Retention Functions

To convert this renegade waterway into a densely vegetated hydrological resource, using standardized means that can correct erosion impacts in other canyons too, we conceived an innovative and fully engineered scalable "drainage restoration" approach.

By intent and by design, this drainage-restoration approach rectifies the costly inadequacies and disturbances of conventional engineering that use grading plans and poured-in-place concrete grade controls at specified locations. Instead, we have engineered tools – in the form of tables, designs, graphics, and instructions to replace such conventions. These are described in detail under DETAILED DRAINAGE RESTORATION DESIGN TOOLKIT SPECIFICATIONS (page 20). All elements minimize impacts, preserve native vegetation, and take advantage of existing beneficial hydrologic and topographical opportunities. This modular element design approach will allow more funds to be used where they should be – in the actual canyon rehabilitation.

Canyon rehabilitation goals are to stabilize the creek bottom, trap sediment, increase habitat and infiltration, and diminish runoff velocity through slope reduction, by installing a limited number of grade control measures. Grade controls will create a series of vegetated close-to-level steps, from the top of each grade control to the bottom of the upstream grade control, up through the canyon. These horizontal stops will both retain sediment and foster broader riparian habitat.



The inspiration for this approach was the flexibility experienced when using stackable concrete blocks in federal soil-retention projects, some massive in size. This stackable concrete-block medium is locally manufactured and can be sized and color-tinted to match conditions. This material can be moved through the canyon and sited with minimal disturbance. The concrete blocks will allow flexibility in implementation and provide the canyon stability required for the reestablishment of native vegetation and sustainable trail access. Equally important, several configuration and siting factors – engineered to withstand 200-year storms – guarantee long-term stability and diminish the likelihood of maintenance issues. These aspects "standardize" the blocks' utility for different locations in Maple Canyon and in other canyons.

This methodology is a stand-alone system, yet its flexibility allows it to be integrated with existing and planned hydrologic, topographic and biological features in coastal canyons throughout San Diego.

Restoration of any canyon floor, through these means, is not dependent on other canyon work; implementation can be easily coordinated with existing and planned infrastructure.

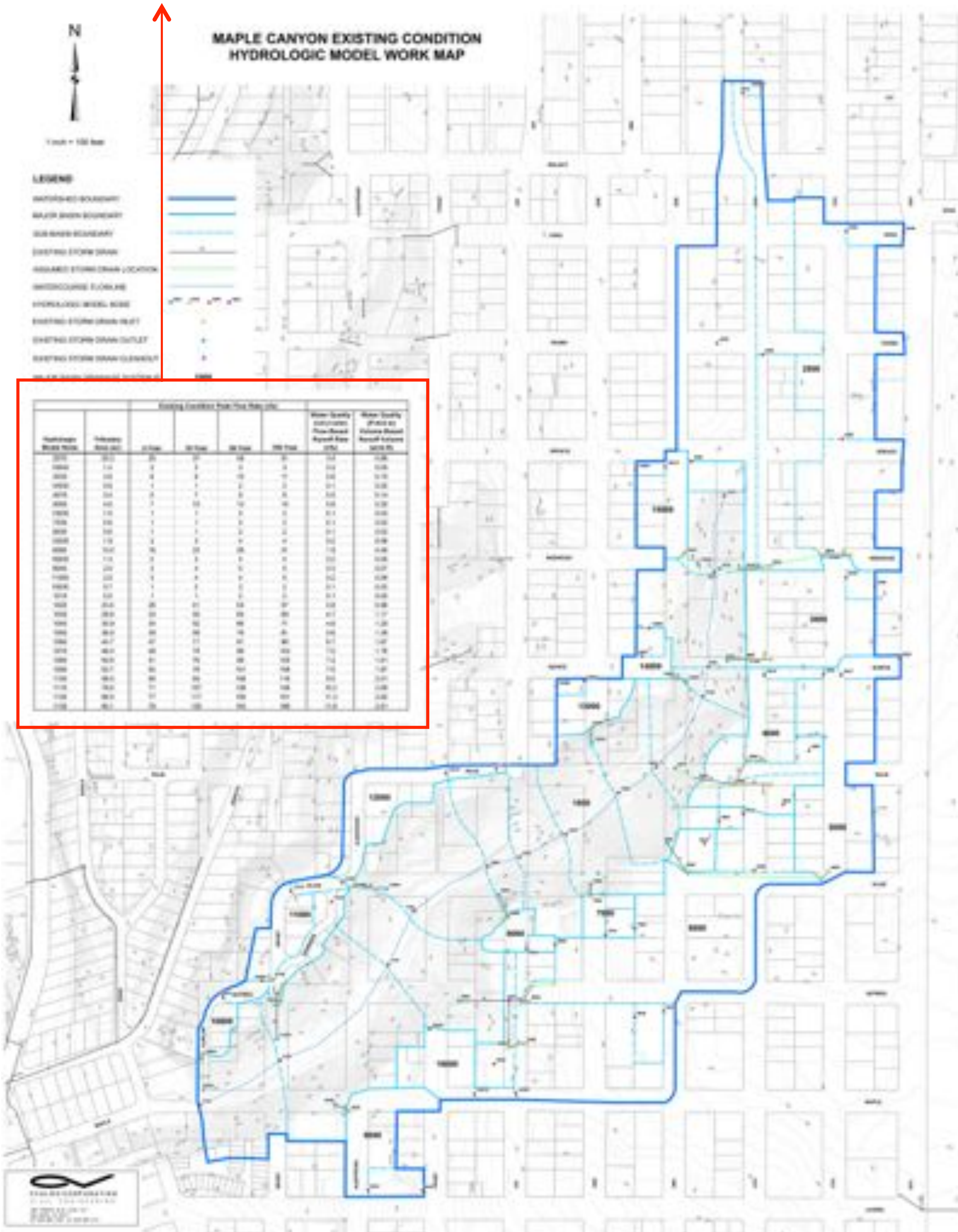
MAPLE CANYON NOTE: This implementation flexibility will accommodate the planned outfalls of Maple Canyon Restoration Phase 1. Should our restoration of Maple Canyon's channel be installed before Phase 1, our contractors will leave to required access and staging areas available. Canyon-floor revegetation will be staged so as to avoid the conflicts between the two projects. Near and around the grade control structures and those areas outside of the Phase 1 project footprint, stream rehabilitation crews will immediately install and maintain native vegetation. After Phase 1 is completed, additional native vegetation will be planted in the remaining areas.

Engineering and Hydrology

Using existing field investigation and the City's most current site survey, SANGIS information, storm-drain outfall designs, and hydrological data from City studies (e.g. the table below), our hydrologist-engineers assessed various flows.

For Maple Canyon, these peak flows are as follows:

		Existing Condition Peak Flow Rate (cfs)					
Hydrologic Model Node	Tributary Area (ac)	2-Year	10-Year	50-Year	100-Year	Water Quality (i=0.2 in/hr) Flow-Based Runoff Rate (cfs)	Water Quality (P=0.6 in) Volume-Based Runoff Volume (acre-ft)
2070	20.2	25	37	48	51	3.4	0.86
15040	1.4	2	3	3	3	0.2	0.05
3030	3.6	6	8	10	11	0.6	0.15
14030	0.6	1	1	2	2	0.1	0.02
4070	3.4	5	7	9	9	0.5	0.14
5050	4.8	7	10	13	14	0.8	0.20
13030	1.0	1	1	2	2	0.1	0.03
7030	0.6	1	1	2	2	0.1	0.02
9030	0.6	1	1	2	2	0.1	0.02
12030	1.9	2	3	4	4	0.2	0.06
6080	13.0	16	23	29	31	1.9	0.46
16020	1.4	2	3	4	4	0.2	0.05
8040	2.0	3	4	5	5	0.3	0.07
11050	2.0	3	4	4	5	0.2	0.06
10030	0.7	1	2	2	2	0.1	0.02
1010	0.5	1	1	2	2	0.1	0.02
1020	23.4	28	41	53	57	3.8	0.96
1030	29.6	33	50	64	69	4.7	1.17
1040	30.9	34	52	66	71	4.8	1.20
1050	36.5	39	59	76	81	5.6	1.39
1060	44.7	47	71	91	98	6.7	1.67
1070	48.4	49	75	96	103	7.0	1.76
1080	50.6	51	76	98	105	7.2	1.81
1090	52.7	52	79	101	108	7.5	1.87
1100	58.5	56	84	108	116	8.0	2.01
1110	76.6	71	107	138	148	10.2	2.56
1120	86.5	77	117	150	161	11.3	2.82
1130	90.1	79	120	154	166	11.6	2.91

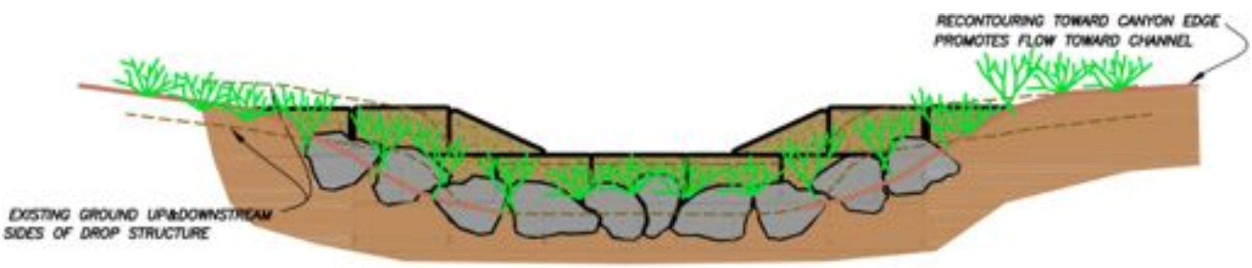


N
MAPLE CANYON EXISTING CONDITION
HYDROLOGIC MODEL WORK MAP
LEGEND

The second step was to design grade-control dimensions calibrated to flows, each a stand-alone modular design, engineered for a range of similar hydrologic site conditions.

Each grade control will consist of stackable large concrete blocks, surrounded by natural stone, soil and vegetation, as follows: Striving for maximum flow of 1.5 feet deep, with one additional foot of freeboard, and engineered to withstand 200-year-storms at the City's request, the resultant designs call for no-higher-than three rows of stackable 4,000 pound blocks, each 2.5' x 2.5' x 5', with 45-degree (1H:1V) or 27-degree (2H:1V) notched blocks on either side of the weirs.

These will be keyed in to not less than 1-foot depth. On the upstream side these will be buried almost entirely. On the downstream side will be a drop of no more than 4 feet. Each grade control will terminate in an energy dissipating natural stone apron, of which only 2-feet will be exposed. This will allow runoff to drop in elevation to the next grade-control level, and retain soil and vegetation. The stone apron also shortens the downstream fall to 2 feet, alleviating safety concerns.



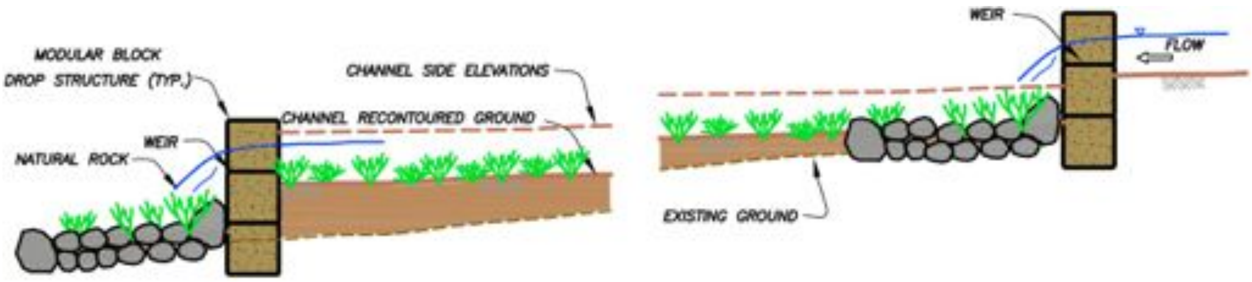
GRADE CONTROL STRUCTURE FRONT VIEW

Weir width and grade control spacing are critical to stream function, channel stability, infiltration and revitalized native habitat. The team identified minimum weir width and maximum spacing as essential design decision-making elements.

The scalable tools therefore include **Minimum Grade-control Weir-widths Table,** which matches minimum dimensions to flows that range up to 292 cfs, as tabulated for 200-year storms in San Diego canyons. Minimum "notch widths" ("weir widths") can, however, be widened in wider reaches of canyons, if an increase in vegetation and/or flow control is desired.

MAPLE CANYON NOTE: *Flows tabulated for a 200-year storm are no greater than 177 cfs.*

In order to ensure stability, an engineered means of siting these structures in the field was developed. The hydrological engineer calibrated the spacing and placement of this succession of grade-control units to block size (2.5' x 2.5' x 5') and not more than a "maximum" elevation gain between structures. For those block dimensions, the **Maximum Elevation Gain between Structures** will always be equal to or less than the elevational gain of the grade-control control structure (e.g. 4 feet), plus an additional 0.5 percent of the horizontal distance (spacing) between structures.



TYPICAL REACH BETWEEN GRADE CONTROL STRUCTURES

Variations in topography, vegetation, trail, and storm drain outfalls may create the need to rotate, shift or move the grade controls, in order to minimize disturbance and to extend plant-establishment areas that assure stable conditions for balanced sediment transport. Thus, the spacing between structures will often vary according to site conditions, but importantly will never be greater than that specified in the **Maximum Elevation Gain Between Structures** formula, that distance that ensures stability. This strategy will allow grade controls to be placed in a variety of locations, as long as the site hydrologic conditions are equal to or less than those of the pre-engineered designed specifications.

Additional engineering and hydrology information follows in the DETAILED DRAINAGE RESTORATION DESIGN TOOLKIT SPECIFICATIONS (page 20).

Recontouring

Integrating all grade controls into the existing topography and storm drain outfall locations is required. Therefore, each grade control will be located (and sometimes widened) to ensure adequate bank embedment and minimize potential for erosion as a result of side drainage. The restoration strategy for the structures includes mounding soil at the edges, recontouring the creek flowline as well as the flowline from side drainages including storm drain outfalls, and then placing natural rock and planting riparian native vegetation – likewise minimizing potential for erosion. In addition to softening the vertical nature of the design, and achieving more natural looking features, this approach stabilizes the channel, eliminates the possibility of end cutting and sedimentation, encourages habitat, and restores healthy stream function.

Naturally contoured, reinforced berms/mounds extending from the sides of some structures (i.e., where needed), will prevent erosion around the grade controls. The berms/mounds will be reinforced with vegetation and buried rock where necessary. Thus, the erosion (and downstream sedimentation) will be reduced to historic lows. The rises between grade controls will be densely planted with native riparian species, which will reduce erosion, trap sediment, and disperse and slow flows. Experience with channel restoration elsewhere suggests that once the vegetation is established, the need for the existing makeshift erosion controls (such as the sediment trap at the bottom of Maple Canyon) will fade.

Where channel conditions are stable, these grade-control measures are unnecessary, and at most bioengineering solutions are adequate.

MAPLE CANYON NOTE: Onsite assessment with a restoration professional, hydrologist, and cultural landscape historian suggest that the paucity of deep-rooted native shrubs, trees and other vegetation left Maple Canyon terrain very vulnerable to erosion and destabilization, particularly in riparian reaches.

An estimated additional 6 acres of riparian mulefat scrub will be added, with up to 10,000 container plants and 150 pounds of riparian-upland transition seed mix. This will include some coast live oaks and sycamores.

Native Vegetation

The role of deep-rooted native vegetation in landform stabilization and water infiltration is well proven. In addition to providing habitat and other ecosystem services, it reduces erosion, trap sediment, and disperse and slow flows. Therefore, revegetation specifications an important aspect of the Toolkit.

Maintenance and Monitoring

Assiduous irrigating during the plant establishment period is critical, as is ongoing weed abatement. Riparian vegetation will gradually mature with precipitation. Guidelines and funding for rigorous and continuing stewardship are central to this and any stream rehabilitation program. The success of the rehabilitations can be measured both by diminishing erosion as well as increased habitat and biomass.

MAPLE CANYON NOTES:

Conditions in upper reaches are more stable (i.e., less active erosion). To reduce disturbance, spacing requirements and treatments will vary with flows, but be applied to address the two places where the south slope is failing – the narrow spot on the trail and the most upstream location's tie-in with the pedestrian bridge. Where volume, rate and erosion are modest, modest bioengineering methods will suffice. There, different gradients of rock will be strategically installed to slow water and reduce erosion.

For fill and recontouring, we propose to use existing soil from a) the sediment trap b) soil already sequestered during the trap's construction a few years ago, and trenching during Phase 1, should Phase 1 happen first.

GRAPHIC DEPICTION OF UPSTREAM AND DOWNSTREAM VIEWS OF CHANNEL TRANSFIGURATION

Before photo, upstream view

Before photo, downstream view

During photo, upstream view

During photo, downstream view

After photo, upstream view

After photo, downstream view

RATIONALE FOR DESIGN APPROACH

The more common design approach – preparing a formal grading plan, including a site survey and detailed restoration/rehabilitation design and specifications – typically consumes limited funds and often, during implementation, requires numerous changes in the field to match actual conditions more closely. This leads to more expense.

<u>By contrast, engineering formulas that leave room for adaptive design and flexibility during implementation, in response to specific and often dynamic on-the-ground conditions, provide a cost-effective, time-saving solution to erosion problems.</u>

1. This approach provides landowners with optimum flexibility during project implementation. Modular design is ideal for adaptive management, and implementation practices can be adjusted (within parameters) quickly to compensate for new or changed site conditions without re-engineering.
2. Since engineering is based on a "worst case" scenario for sites, the design eliminates requirements for detailed geotechnical, boring, and soils analysis that can result in significant additional costs, especially when considering larger sites with multiple project locations.
3. This design method reduces requirements for detailed topographical surveys. Design specifications are based on the pre-engineered unit, which is then placed onto the site with specific conditions. This is particularly beneficial in heavily eroded drainages where site conditions can change dramatically in one season. Detailed topographical surveys can quickly become obsolete, requiring additional surveys prior to construction.
4. This design method allows for field adjustment to adapt design to maximize project benefits for a site. If additional water infiltration and riparian vegetation is desired, grade controls can be widened within canyon topography to accommodate this requirement.
5. This design method minimizes potential conflicts with existing site limitations. Grade control placements can be positioned to minimize impacts to existing sensitive resources including sensitive habitat and cultural resources. In addition, this flexibility allows avoidance of conflicts with canyon infrastructure including sewer manholes and other existing or planned infrastructure.
6. This design method and system can be readily incorporated with other planned and ongoing work, and/or easily adjusted to other projects, concurrent or subsequent. In Maple Canyon for example, grade control structures can be re-positioned to complement new drainage outfalls, thereby further reducing canyon scour between the outfalls and the canyon floor. Additionally, soil excavated and stockpiled from the sediment basin can be easily incorporated into this design, thereby reducing costs associated with soil transportation and disposal.
7. The pre-engineered units are modular, and this concept can be applied to other canyons requiring only hydrologic analysis for establishing flow rates.
8. The design is modular and can be moved or completely removed to adapt to future land use changes.
9. Because the system is engineered to specific flow rates and topography, and the revegetation will soon mature, system maintenance is not anticipated. Nevertheless, long-term maintenance by the non-profit is a planned funding objective.

DETAILED DRAINAGE REHABILITATION DESIGN

Toolkit Specifications

In order to recreate a nuanced, stable, and functioning ephemeral stream habitat, the following design tools are necessary. The list below summarizes these, with their existing level of completion in *red italics*. References to engineering drawings and other appendices are in parentheses. Once complete, the Design Toolkit Specifications will represent 100% design level for Maple Canyon, sufficient for permitting and implementation in the field.

Hydrologic Data, keyed to specific locations in the drainage

- Hydrologic calculations - used to develop ranges, to which the various design elements are sized. (See Existing Condition Hydrologic Map and Summary Tables.)
- Peak flow rates in Maple Canyon as delivered from the fifteen[1] storm drains and areas upstream, re-tabulated to 200-year storm levels.
- Wetlands Delineation (See files appended.)

Inventory of Important Existing Landscape Features

- Topography - from SANGIS or other sources
- Storm-drain outfalls *(awaiting City's final design)*
- Native vegetation (See Biologic Resources Constraints Report and Maple Canyon Vegetation Communities Map)
- Site Investigation/documentation
- Erosion markers *(Inventory canyon closer to implementation.)*
- Trail (Reference Site Survey)

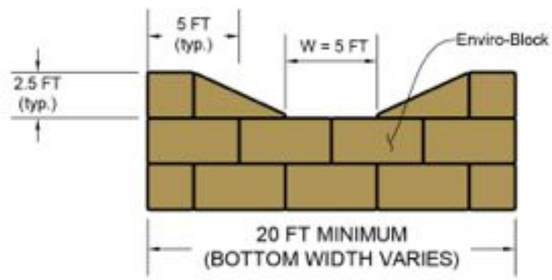
Bioengineering Solutions

For the most part, higher elevations in upstream reaches of the canyon are not badly eroded or incised. These smaller, less-eroded reaches of the upper channel near the top of the restoration area can be enhanced, stabilized, and restored with selective logs and/or natural stone placement and strategic planting, to lower velocities, increase runoff absorption, and stimulate plant growth. While this document does not describe the effective bioengineering tools and techniques detailed in numerous federal (NRCS, USFWS, EPA, etc.) and state agency documents, these tools are incorporated into this approach.

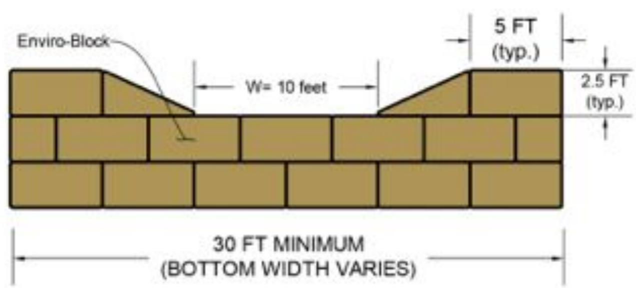
[1] Maple Canyon Phase 1 calls for sixteen storm drain inlets above Maple Canyon. The storm drains at Palm Street will be coupled part way down the slope, such that only fifteen storm drain outfalls will reach the bottom of the slope. The existing storm drain at Curlew Street will remain but is not part of Maple Canyon Phase 2.

Range of Modular Grade Control Structure Designs

Material description: The modular grade control elements consist of stackable, pre-manufactured concrete blocks, sized and manufactured locally. These 4000-pound blocks – some rectangular, some trapezoids with 1:1 or 2:1 (horizontal:vertical) slope on one facet – will be tinted to match existing soil and canyon geology. Natural stone boulders, appropriately sized (light class to ¼ ton) will be placed immediately downstream of each structure, and where applicable, at the ends of structures (to address any risk of end cutting).



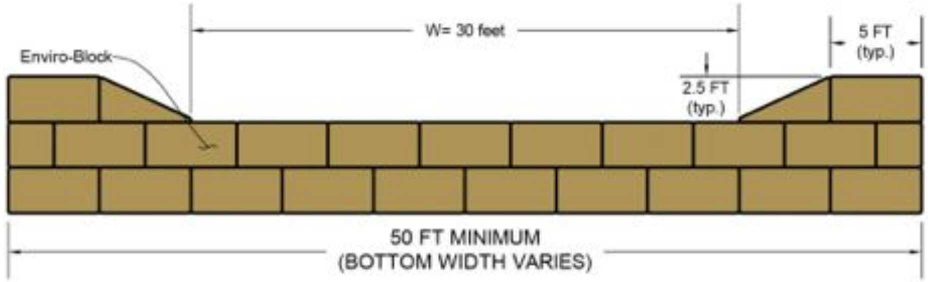
5 FOOT WEIR



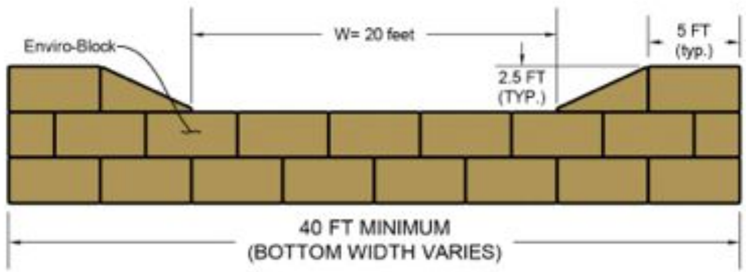
10 FOOT WEIR

FRONT VIEW GRADE CONTROL STRUCTURE OPTIONS A and B
NO SCALE

Engineered design: Since the intent is to enhance riparian vegetation and create a wider channel bottom, the engineered designs establish a range of different versions (configurations) of this methodology. Due to variables of flow rate and canyon/channel formation (longitudinal slope and cross sections perpendicular to the flow), the configuration is scalable, varying only in width, depth, size of notch, and energy-dissipating details. Providing *minimum values* will allow increases in structure length to meet specific site conditions and site-restoration requirements. For example, if hydrologic conditions require a minimum 8-foot wide by 1-foot deep flow area during a 200-year flood event, the width of the grade-control notch would not necessarily be 10 feet, but can be increased above the minimum to match surrounding site conditions better.



30 FOOT WEIR



20 FOOT WEIR

FRONT VIEW GRADE CONTROL STRUCTURE OPTIONS C and D
NO SCALE

Table of Minimum Grade-Control Weir Width

To clarify the modular grade control, the drawings and supporting calculations for pre-engineered gravity elements are made to withstand forces acting against them up to a 200-year storm level, as the structural calculations and table below indicate. In Maple Canyon, these 200-year flows range only from 76 to 177 cubic feet per second.

Range of Flow Defines Drop Structure Weir Width

This is the fundamental guiding engineering feature in the toolkit

Range of Flows (cfs)*			Minimum Width of Weir (ft)
0	to	44	5
44	to	72	10
72	to	99	15
99	to	127	20
127	to	154	25
154	to	182	30
182	to	209	35
209	to	237	40
237	to	292	50

* max. 200-year flow at 1.5 feet deep, 1 foot of freeboard

NOTE: Additional blocks may be needed to blend into existing ground on each side

Grade Control Siting Instructions for Maple Canyon

Based on hydrologic and hydrogeomorphic criteria (including natural slope) within Maple Canyon, the maximum spacing between structures will occur at no more than each 4-foot elevation gain plus 0.5% x (times) the finished grade between structures. Based on this formula, where the existing channel bed is unstable, the spacing will be less than 200 feet.

Maximum Elevation Gain Between Structures
≤
4-Foot Elevation Gain + 0.5% x Horizontal Distance (Spacing) between Structures

Sample of Grade Control Structure Spacing at Maple Canyon

Based on Maximum 4-foot Elevation Gain and Maximum 0.5% Slope between Structures

Structure Number	Station	Spacing Between Structures (ft)	Elevation (ft) D/S End of Structure	Elevation of Weir (ft)	Elevation Gain (ft)
1	0	----	90.0	94.0	----
2	120	120	94.6	98.6	4.6
3	190	70	99.0	103.0	4.3
4	300	110	103.5	107.5	4.6
5	415	115	108.1	112.1	4.6
6	570	155	112.9	116.9	4.8
7	675	105	117.4	121.4	4.5
8	775	100	121.9	125.9	4.5
9	900	125	126.5	130.5	4.6
10	998	98	131.0	133.0	2.5
11	1033	35	133.2	135.2	2.2
12	1228	195	138.0	142.0	6.8
13	1348	120	142.6	146.6	4.6
14 to 23*	----	----	147.0	200.0	----

* up to 10 drop structures, each 10 feet wide weir

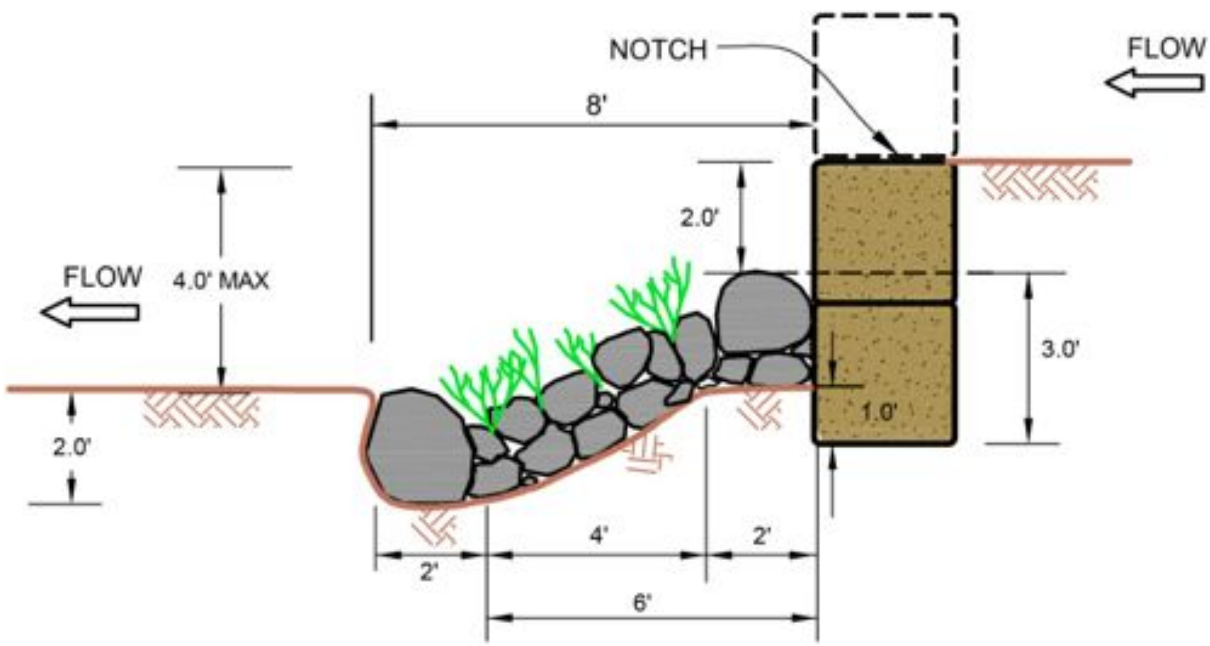
NOTE: This is a sample only based on hydrology and geomorphology. Variations in topography, vegetation, trail, and storm drain outfalls create opportunities to rotate, shift or move the drop structures to minimize disturbance and to extend plant-establishment areas that assure stable conditions for balanced sediment transport.

To achieve stability, the spacing and placement of all grade-control structures will begin at the lowest elevation. Selective placement will be based on the maximum horizontal spacing from the closest grade control downstream, using the formula above. To space subsequent grade controls from this first structure, contractors will proceed up the linear course of the channel. Spacing will be selected such that the resulting elevation gain will not exceed the established maximum, with the understanding that the distance between structures may be reduced better to utilize existing site conditions. Avoidance of established trees, native vegetation, infrastructure, and other erosional features, such as flows entering the canyon from the sides, will all be considered in this placement. Actual location will be determined in the field to avoid impacts to existing mature and desirable vegetation or other constraining factors. However, it will never be greater than the maximum horizontal distance as described above.

Each grade-control structure ensures the stability of the next structure upstream. Therefore, particular attention must be paid to siting the downstream-most structure relative to an existing stable and/or hardened boundary. To address the sediment trap and current gullying below the sediment trap, the engineer, hydrologist and engineering contractor suggest the following placement for the initial grade-control measures:

Because Maple Street itself, at the mouth of the canyon, is stable and defines the elevation of the downstream-most boundary, that location functions as the initial elevation point.

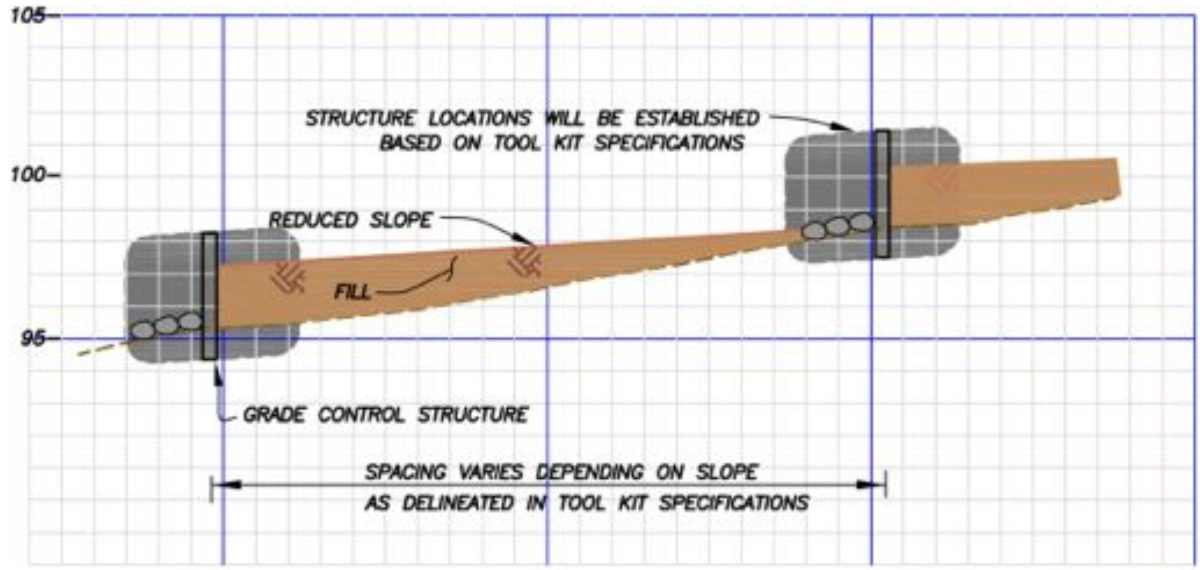
Starting at that asphalt road, but well clear of the trail, the first modular grade control can be installed at maximum of 4 vertical feet elevation gain up-gradient, plus the additional 0.5% x the horizontal distance (spacing) between the road and the first structure. This will allow for the one-foot keyed grade control footing below grade, as detailed in the toolkit specifications.



TYPICAL SECTION GRADE CONTROL STRUCTURE
WITH ROCK FOR ENERGY DISSIPATION

The second grade-control will likewise be constructed a maximum of 4 vertical feet above the initial grade control weir, plus 0.5% of the horizontal distance (spacing) between the two structures.

Above this second grade control is the approximate location of the City-maintained sediment trap. We are confident that the new grade controls and maturing vegetation will eventually eliminate the need for the sediment basin. However, should the City choose to continue to maintain this sediment trap and potentially incorporate a future drop-inlet drainage structure where the canyon meets Maple Street, the third grade-control structure will be constructed with a deeper key and footing to accommodate excavation associated with periodic removal of sediment from the basin.



PROFILE: TYPICAL GRADE CONTROL REACH
NO SCALE

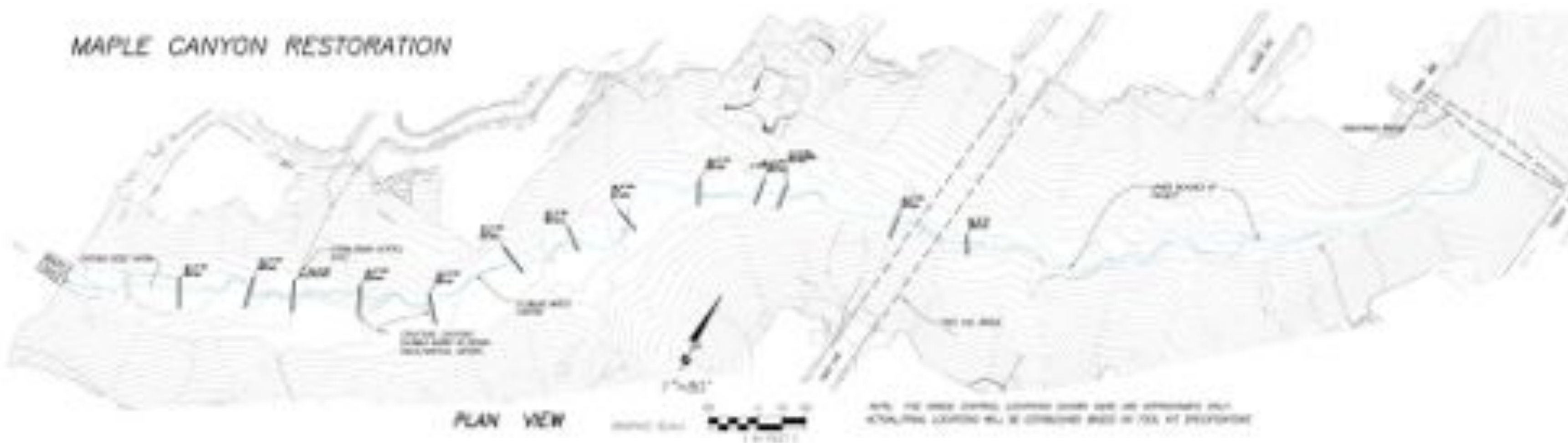
Due to the additional requirements, this third drop structure would be a unique application specifically designed to minimize the potential for undermining. *Prior* to the construction of this third grade control, its design and installation will require coordination with the City to establish both sediment-trap containment capacity requirements and the prospective drop inlet drainage design.

Subsequent grade controls upstream shall all be constructed as engineered by the design toolkit specifications.

The elevation gain between each structure consists of three parts, as depicted in the associated figures: a maximum 2-foot vertical gain at the block structure is preceded by a maximum 2-foot gain within the rock placement immediately below the block structure, creating a maximum 4-foot gain within the footprint of the “grade control” (defined as the block structure and rock together). Additionally, each structure is keyed in no less than one foot below soil grade.

To determine the aforementioned locations in the field, a licensed Engineering Contractor, with extensive habitat restoration experience, who is himself a biologist, together with an engineer specializing in stream rehabilitation, will survey current terrain, vegetation, trail, and storm-drain outlet conditions, and then locate the structures consistent with the variables of flow rate and volume, longitudinal slope, and cross sections perpendicular to the flow.

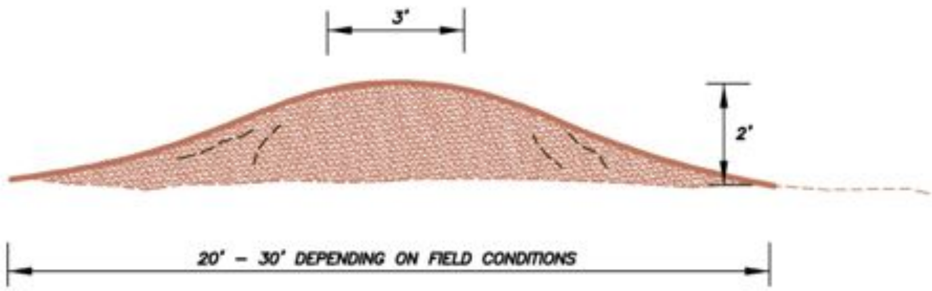
The engineer has prepared a "General Conceptual Plan Indicating Approximate Locations" that incorporates the elements for application to Maple Canyon, in size, canyon-floor slope, vegetation and accessibility. This plan is preliminary only, to inform but not determine ultimate placements. Topographic mapping, together with a field investigation to document site-specific conditions, was used to prepare this general conceptual plan. With the general conceptual plan, an experienced restoration/rehabilitation contractor will be able to bid the design later determined in the field accurately.



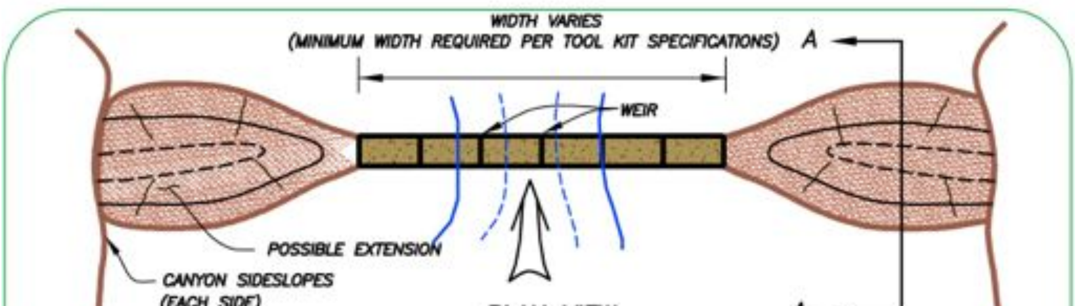
Based on the 53-foot elevation gain in Maple Canyon, between the sediment trap and the First Street Bridge, an estimated 12 structures are necessary. Between the First Street Bridge and the pedestrian bridge at Quince Street, an estimated 7 structures are necessary.

Recontouring Instructions

Configure the channel and grading, so the top of the notch of each downstream “step” is level with or slightly lower than the bottom of the next step upstream. These “close-to-level” created wetland areas between rises will be graded to withstand a 200-year storm. In Maple Canyon, this flow ranges from 76 cubic feet per second at the pedestrian bridge to 177 cubic feet per second downstream at the sediment trap. Implementation will be such that sediment balance is achieved and the canyon bottom is stabilized. Importantly, grading will tie in with planned and/or new storm-drain outlets.



SECTION A–A
MOUNDED BERM



PLAN VIEW
TYPICAL RESTORATION
GRADE CONTROL STRUCTURE

After the establishment of grade control locations and elevations, the site will be contour-graded. Channel recontouring will consist of re-shaping the drainage bottom between the new grade controls to establish a flat-bottomed, gently sinuous and naturalistic drainage channel, with a minimum width being no less than the width of the grade-control flow notch. Again, channel width may be widened to enhance water infiltration and riparian vegetation restoration opportunities in areas where surrounding topography permits. Work may include limited cut and fill in areas where channel incision has resulted in gully formation. The project will use available soil resources as are practicable/feasible, reducing or eliminating the need for imported soils. Where needed, channel bank slopes will be recontoured with slope gradients 5:1 or flatter where feasible. This will help reduce erosion and will provide a zone for transitional species. Recontouring efforts will blend the new drainage channel and associated banks with the surrounding canyon slopes. This will result in a natural canyon appearance and will facilitate re-vegetation efforts for both riparian and upland plant species.

Integrating the grade controls into the existing topography is essential. The restoration strategy for the structures will mound soil at the edges, recontour the creek flowline, place natural rock and vegetate with riparian native plants. In addition to softening the vertical nature of the design, and more natural looking features, this approach stabilizes the channel, eliminates the possibility of end cutting and sedimentation, encourages habitat, and restores healthy stream functions.

Installation Instructions

Specifications in the *Field Construction Guidelines,* near completion, include instructions for site access, excavating, installing and keying in the grade control measures, including erosion-control fabric placed underneath the stonework, energy-dissipating natural stone apron, and trail. Where added features are necessary to tie in with new storm-drain outlets, instructions will be specified.

Revegetation Instructions

Partial funding for Maple Canyon habitat restoration plan is provided by the California Coastal Conservancy. *Additional funding is needed to complete it.* Revegetation includes maintenance through establishment period, followed by at least five years of San Diego Canyonlands educational and stewardship programs.

Salt Grass
Mulefat
Deer Grass
Mugwort
San Diego Marsh Elder
Arrow Weed
California Rose
Coast Live Oak
Broom Baccharis
Blue Elderberry
Western Sycamore

Monitoring

Storm Water Division has suggested hiring AECOM to review our engineering and monitor our implementation. In addition, we are building a five-year monitoring and adaptive management period into the project. *These criteria are yet to be developed.*

Maintenance

San Diego Canyonlands is committed to long-term maintenance via its on-going volunteer stewardship programs and will be applying for funding specifically for Maple Canyon. The community has been engaged on a monthly basis for nearly 18 months with lots of continued support from volunteers from the nearby Naval Station, UCSD students. A nearby environmental consulting business, RECON Environmental, has “adopted” Maple Canyon and supported restoration for six years now. The project footprint is within dedicated open space in the purview of the City of San Diego's Open Space Division, and has its own rangers and contracts for tree removal, brush management and twice-yearly illegal dumping removal.

PERMITTING

Presentation at the Pre-ap Agencies meeting and further discussion with the USACE lead us to conclude that the project will require a USACE Nationwide 27, a RWQCB 401, and a CDFW Streambed Alteration Agreement 1602. To inform these permits we intend to submit CRAM assessment(s), Wetlands Delineation, Maple Canyon Existing Condition Hydrologic Model Work Map (including peak-flow rates), Vegetation Map, Access Points (to avoid sensitive species), Endangered Species Surveys, Cultural Resources Report, NCRS Soil Survey, Hydrology Plan, Engineering Drawings, Tables, and Implementation Guidelines, Restoration Plan, Calculation of Wetland Habitat Created. Analysis of survey data will determine the CEQA process. We are optimistic that a Categorical Exemption or Negative Declaration may be possible.

Communication with the Regional Board staff March 16, 2017 led us to believe that our next task is to apply for the 401, with which the Regional Board has agreed to help us. Staff wrote that they *doubt this project will be eligible for the general certification for ecological restoration due to size exceedance, therefore, the 401 will be an individual permit. These projects tend to actually be more complicated and time intensive because they are not straightforward and require some explanation as to why mitigation is not required or that the project is self-mitigating. Eric* [Becker] *makes an effort to have restoration projects not get waylaid behind the backlog.*

Our consultant has used the latest fee calculator for the 401 program for budget planning purposes.

BUDGET *This isn't yet complete*

TEAM

<u>San Diego Canyonlands</u>

Established in 2008, San Diego Canyonlands (SDCL) is a 501 c(3) whose mission ***is to promote, protect and restore the natural habitats in San Diego County canyons and creeks.*** The organization fosters education and ongoing community involvement in stewardship and advocacy, and by collaborating with other organizations.

San Diego Canyonlands' board of directors and staff, including Executive Director Eric Bowlby, have over sixteen years of experience developing dozens of stewardship or "Friends Groups" throughout San Diego County to care for and restore their neighborhood canyons. About 35 of these groups have routine stewardship events in their neighborhood canyons, most of them monthly. Bowlby served ten years on the City of San Diego's Wetlands Advisory Board and has served on the City's Open Space/Canyons Advisory Board since its inception in 2002.

A huge catalyst for SDCL's growth and ability to restore urban canyons is the development of the highly successful "Canyon Enhancement Planning" (CEP) program. After mapping the existing conditions in each canyon, this program pulls together the community and agency stakeholders to develop comprehensive plans for trails, habitat restoration and other amenities. Two recent examples of plans that have been funded, at least in part, are the Oak Park Branch of Chollas Creek (over $1M awarded for building the trail system), and Rueda Canyon in Tierrasanta, ($463,000 in Prop 1 funds for restoration of the riparian corridor including removal of 263 mature palm trees).

Years of collaboration with the City's Open Space Division, including participation in SDCL's CEP program, have resulted in:

- The planning of eight urban canyons/creek segments and at least partial funding to implement all of these plans;
- The establishment of a Master Right of Entry for SDCL to access all City open spaces including parks and right of way to implement restoration/enhancement plans;
- City funding toward Programmatic CEQA documentation and a Master Site Development Permit for specific, non-exempt projects such as trails.

<u>TRW Engineering, Inc.</u>

As leaders in the water resources industry, TRWE is known for expertise in surface water disciplines and for innovative ways of integrating these disciplines. TRWE offers services in watershed, floodplain and stormwater management, river restoration, flood facilities design, and sedimentation and erosion control methods. Averaging 30 years of experience, TRWE's Professional Engineers have analyzed and/or designed many hydraulic structures, including flood channels, stormwater quality facilities, and detention, retention, and debris basins. The team has also completed regional drainage master plans, hydrologic model calibrations, and numerous hydromodification studies.

TRWE has specialized experience in innovative flood control designs, high-quality habitat restoration planning, successful permitting strategies, and thorough administration of construction implementation. Team members have significant experience addressing CEQA issues related to surface water, and preparing the necessary technical reports. Numerous projects have included conceptual plans that specify grading, drainage, and erosion control methods. Many of those projects have extended into the construction phase with coordination for design, observation, monitoring, and inspection.

Combining flood control expertise with the study of rivers and creeks has helped create solutions and designs that blend with the natural beauty of the water bodies. TRWE is known for using natural materials whenever possible, to design flood control elements such as grade control and weir structures. The TRWE team takes great pride in understanding the complexities of watersheds and the drainage systems within each watershed, and continually stays abreast of ever-changing rules and regulations. The extensive use of industry-recognized, state-of-the art software for hydrologic and hydraulic modeling translates into reliable results for clients.

Apex Contracting and Consulting, Inc.

Apex Contracting and Consulting, Inc. was founded with a mission to set standards of excellence for providing natural resource management services. We are a multidisciplinary team of professionals who have years of experience within their respective specialties. We can assist our clients with project design, coordination, construction implementation and/ or management, and technical and engineering support. Our innovative approach allows us successfully to implement complex projects with a variety of constraints including projects in sensitive habitat, those containing endangered species, and on sites with limited or difficult access.

Our team at ACCI has years of experience designing and implementing habitat restoration for both compliance mandated mitigation and general land stewardship projects. Our multidisciplinary team of ecologists, biologists and botanists can provide our clients with innovative and economical methodologies for implementing successful habitat restoration and creation projects. Our team has completed projects in a wide range of habitat community types including wetlands and riparian, vernal pools, coastal dune, coastal sage scrub, desert, and other communities.

ACCI services include Planning and Design, Site Preparation and Project Construction, and Maintenance and Monitoring. We are committed to giving nothing short of the most outstanding contracting services, the highest quality of work and unparalleled support for our clients.

Olivia Thall Productions

Olivia Thall is an architectural and graphic designer from San Diego currently working under Roy McMakin at Domestic Architecture, just a few blocks away from Maple Canyon. She graduated from New School of Architecture with a B.Arch degree focused on sustainability and site-driven design in conjunction with graphic production skills. Her services provided include document presentation, renderings, line drawings, photography and research.

Tershia d'Elgin

Social activist, author and wetland contractor Tershia d'Elgin achieved recognition for organizing a citizen-based canyon restoration in San Diego's 32nd Street Canyon, which began in 2001. The 32nd Street Canyon Task Force, with support from environmental groups, agencies and politicians successfully averted the canyon's destruction and raised over a half-million dollars for its restoration, outdoor education, and the founding of a watershed group. Largely through volunteers, the canyon was transformed from a badly blighted "island," infested with arundo and acacia, homeless and meth encampments and illegal dumping, with little native vegetation, into an outstanding, award-winning community amenity. Several projects required contractors, including the removal of 50 cubic yards of soil and re-contouring. She administered numerous private, state and federal grants through the Greater Golden Hill Community Development Corporation and Groundwork San Diego. For this work, she was widely recognized and also received two congressional acknowledgements.

In 2016, City of San Diego biologist censused the endangered species, gnatcatchers, in 32nd Street Canyon.

As noted by Natural History Museum ornithologist Phil Unitt about 32nd Street Canyon: *Yesterday morning 21 February [2015] I decided to visit another of the canyons covered by Soulé et al. in their 1988 paper "Reconstructed Dynamics of Rapid Extinctions of Chaparral-Requiring Birds in Urban Habitat Islands" (Conservation Biology 2:75-92). During their surveys of this canyon in the mid-1980s the Wrentit was the only "chaparral-requiring" bird noted. No surprise, yesterday I found three territories of Bewick's Wren, plus a singing California Thrasher, both lacking in the 1980s. But the habitat is now greatly changed for the better. Whereas in the 1980s Soulé et al. estimated the coverage of chaparral/sage scrub in this canyon at only 15%, since then there has been an ambitious and successful effort at habitat restoration. Along the canyon bottom are the dead and decaying rhizomes of the invasive Arundo donax, grown over by mature native shrubs. Lesser Goldfinches were swarming the Baccharis, feeding on the seeds and singing like crazy. Another gauge of the success of the restoration was two Fox Sparrows.*

At a Colorado farm, she raised financing and project managed the bioengineered restoration a river embankment with cottonwood and willow, and has extended wetland there by 40 acres. In addition, Tershia worked with H2O Futures, an environmental consulting firm to restore a creek bank in San Marcos and deliver a Sustainable Water Supply Alternatives for the San Pasqual Basin, in contract to the City of San Diego and in concert with the University of Arizona.

Tershia is the author of *The Man Who Thought He Owned Water: On the Brink with American Farms, Cities and Food*, published by the University Press of Colorado, acknowledged by Colorado Humanities, and in its third printing. She served for 12 years on the City of San Diego's Community Forest Advisory Board. Tershia is the recipient of several literary awards.